IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

RAMOT AT TEL AVIV UNIVERSITY LTD.,

Plaintiff,

v.

CISCO SYSTEMS, INC.,

Defendant.

Case No. 2:19-cv-00225-JRG

CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER

Before the Court is the opening claim construction brief of Ramot at Tel Aviv University Ltd. ("Plaintiff") (Dkt. No. 66, filed on April 7, 2020),[1] the response of Cisco Systems, Inc. ("Defendant") (Dkt. No. 71, filed on April 21, 2020), and Plaintiff's reply (Dkt. No. 74, filed on April 28, 2020). The Court held a hearing on the issues of claim construction and claim definiteness on May 11, 2020. Having considered the arguments and evidence presented by the parties at the hearing and in their briefing, the Court issues this Order.

[1] Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through ECF.

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I. BACKGROUND

Plaintiff alleges infringement of three U.S. Patents: No. 10,033,465 (the "'465 Patent"), No. 10,270,535 (the "'535 Patent"), and 10,461,866 (the "'866 Patent") (collectively, the "Asserted Patents"). The Asserted Patents are related to each other through continuation applications and each lists an earliest priority claim to an application filed on June 13, 2007.

In general, the Asserted Patents are directed to technology for modifying the response of an optical modulator from its natural response to a different response.

The abstracts of the '465 and '535 Patents are identical and provide:

> A system for converting digital data into a modulated optical signal, comprises an electrically controllable device having M actuating electrodes. The device provides an optical signal that is modulated in response to binary voltages applied to the actuating electrodes. The system also comprises a digital-to-digital converter that provides a mapping of input data words to binary actuation vectors of M bits and supplies the binary actuation vectors as M bits of binary actuation voltages to the M actuating electrodes, where M is larger than the number of bits in each input data word. The digital-to-digital converter is enabled to map each digital input data word to a binary actuation vector by selecting a binary actuation vector from a subset of binary actuation vectors available to represent each of the input data words.

The abstract of the '866 Patent provides:

> In a modulation system that modulates and transmits an optical signal over at least one optical fiber in response to an input digital data word of N bits, there is an input enabled for receiving the digital data word; an electrically controllable modulator having one or more waveguide branches, where each branch receives an input of an unmodulated optical signal; and a digital to digital converter enabled for converting the N bits to a digital drive vector corresponding to M drive voltage values, where M>N and N>1. The electrically controllable modulator couples the drive voltage values to the unmodulated optical signal(s). The coupling enables pulse modulation of the unmodulated optical signal(s) thereby generating pulse modulated optical signal(s). The electrically controllable modulator outputs the pulse modulated optical signal(s) to one or more outputs that are enabled for transmitting the pulse modulated optical signal(s) over at least one optical fiber.

Claim 1 of the '465 Patent, Claim 1 of the '535 Patent, and Claim 7 of the '866 Patent, exemplary asserted claims, recite as follows (with disputed terms emphasized):

'465 Patent Claim 1. A method for converting digital electrical data into modulated optical streams, said method comprising

inputting into an optical modulator N bits of digital data in parallel, N being larger than 1;
mapping a set of N input values corresponding to said N bits of digital data to a vector of M voltage values where M is equal to or larger than N;
driving at least M electrodes of the optical modulator, enabled to pulse modulate at least an input optical stream, responsively to the M voltage values, to provide at least a ***pulse modulated*** output optical stream.

'535 Patent Claim 1. A method of modulating and transmitting an optical signal over an optical fiber in response to N bits of digital data in parallel, the method comprising:
inputting the N bits of digital data into an optical modulator having a plurality of waveguide branches, where each branch has an input of an unmodulated optical signal;
converting the N bits of digital data to M drive voltage values, where M>N and N>1;
coupling the M drive voltage values to the unmodulated optical signal, said coupling enabling pulse modulation of the unmodulated optical signal, thereby generating a pulse modulated optical signal; and transmitting the ***pulse modulated*** optical signals over an optical fiber.

'866 Patent Claim 7. A method for converting digital electrical data into one or more modulated optical streams using a modulation system, said method comprising:
inputting into a digital to digital converter coupled to an electrically controllable optical modulator N bits of a digital data word, N being larger than 1;
using the digital to digital converter for mapping a set of N input values corresponding to the N bits of digital data word to a digital drive vector corresponding to M drive voltage values where M is larger than N;
coupling the drive voltage values corresponding to the digital drive vector to the electrically controllable optical modulator, enabled to modulate by pulse modulation one or more unmodulated input optical signals, responsively to the drive voltage values, to provide one or more ***pulse modulated*** output optical signals.

II. LEGAL PRINCIPLES

A. Claim Construction

"It is a 'bedrock principle' of patent law that 'the claims of a patent define the invention to which the patentee is entitled the right to exclude.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312

(Fed. Cir. 2005) (en banc) (quoting *Innova/Pure Water Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1115 (Fed. Cir. 2004)). To determine the meaning of the claims, courts start by considering the intrinsic evidence. *Id.* at 1313; *C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 861 (Fed. Cir. 2004); *Bell Atl. Network Servs., Inc. v. Covad Commc'ns Group, Inc.*, 262 F.3d 1258, 1267 (Fed. Cir. 2001). The intrinsic evidence includes the claims themselves, the specification, and the prosecution history. *Phillips*, 415 F.3d at 1314; *C.R. Bard*, 388 F.3d at 861. The general rule—subject to certain specific exceptions discussed *infra*—is that each claim term is construed according to its ordinary and accustomed meaning as understood by one of ordinary skill in the art at the time of the invention in the context of the patent. *Phillips*, 415 F.3d at 1312–13; *Alloc, Inc. v. Int'l Trade Comm'n*, 342 F.3d 1361, 1368 (Fed. Cir. 2003); *Azure Networks, LLC v. CSR PLC*, 771 F.3d 1336, 1347 (Fed. Cir. 2014) ("There is a heavy presumption that claim terms carry their accustomed meaning in the relevant community at the relevant time.") (vacated on other grounds).

"The claim construction inquiry . . . begins and ends in all cases with the actual words of the claim." *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1248 (Fed. Cir. 1998). "[I]n all aspects of claim construction, 'the name of the game is the claim.'" *Apple Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1298 (Fed. Cir. 2014) (quoting *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998)). First, a term's context in the asserted claim can be instructive. *Phillips*, 415 F.3d at 1314. Other asserted or unasserted claims can also aid in determining the claim's meaning, because claim terms are typically used consistently throughout the patent. *Id.* Differences among the claim terms can also assist in understanding a term's meaning. *Id*. For example, when a dependent claim adds a limitation to an independent claim, it is presumed that the independent claim does not include the limitation. *Id*. at 1314–15.

"[C]laims 'must be read in view of the specification, of which they are a part.'" *Id*. (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed. Cir. 1995) (en banc)). "[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Id*. (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)); *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002). But, "'[a]lthough the specification may aid the court in interpreting the meaning of disputed claim language, particular embodiments and examples appearing in the specification will not generally be read into the claims.'" *Comark Commc'ns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1187 (Fed. Cir. 1998) (quoting *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1571 (Fed. Cir. 1988)); *see also Phillips*, 415 F.3d at 1323. "[I]t is improper to read limitations from a preferred embodiment described in the specification—even if it is the only embodiment—into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited." *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004).

The prosecution history is another tool to supply the proper context for claim construction because, like the specification, the prosecution history provides evidence of how the U.S. Patent and Trademark Office ("PTO") and the inventor understood the patent. *Phillips*, 415 F.3d at 1317. However, "because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Id.* at 1318; *see also Athletic Alternatives, Inc. v. Prince Mfg.*, 73 F.3d 1573, 1580 (Fed. Cir. 1996) (ambiguous prosecution history may be "unhelpful as an interpretive resource").

Although extrinsic evidence can also be useful, it is "'less significant than the intrinsic record in determining the legally operative meaning of claim language.'" *Phillips*, 415 F.3d at 1317 (quoting *C.R. Bard, Inc.*, 388 F.3d at 862). Technical dictionaries and treatises may help a court understand the underlying technology and the manner in which one skilled in the art might use claim terms, but technical dictionaries and treatises may provide definitions that are too broad or may not be indicative of how the term is used in the patent. *Id*. at 1318. Similarly, expert testimony may aid a court in understanding the underlying technology and determining the particular meaning of a term in the pertinent field, but an expert's conclusory, unsupported assertions as to a term's definition are not helpful to a court. *Id*. Extrinsic evidence is "less reliable than the patent and its prosecution history in determining how to read claim terms." *Id*. The Supreme Court has explained the role of extrinsic evidence in claim construction:

> In some cases, however, the district court will need to look beyond the patent's intrinsic evidence and to consult extrinsic evidence in order to understand, for example, the background science or the meaning of a term in the relevant art during the relevant time period. *See, e.g., Seymour v. Osborne*, 11 Wall. 516, 546 (1871) (a patent may be "so interspersed with technical terms and terms of art that the testimony of scientific witnesses is indispensable to a correct understanding of its meaning"). In cases where those subsidiary facts are in dispute, courts will need to make subsidiary factual findings about that extrinsic evidence. These are the "evidentiary underpinnings" of claim construction that we discussed in *Markman*, and this subsidiary factfinding must be reviewed for clear error on appeal.

Teva Pharm. USA, Inc. v. Sandoz, Inc., 574 U.S. 318, 331–32 (2015).

B. Departing from the Ordinary Meaning of a Claim Term

There are "only two exceptions to [the] general rule" that claim terms are construed according to their plain and ordinary meaning: "1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of the claim term either in the

specification or during prosecution."[2] *Golden Bridge Tech., Inc. v. Apple Inc.*, 758 F.3d 1362, 1365 (Fed. Cir. 2014) (quoting *Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012)); *see also GE Lighting Solutions, LLC v. AgiLight, Inc.*, 750 F.3d 1304, 1309 (Fed. Cir. 2014) ("[T]he specification and prosecution history only compel departure from the plain meaning in two instances: lexicography and disavowal."). The standards for finding lexicography or disavowal are "exacting." *GE Lighting Solutions*, 750 F.3d at 1309.

To act as his own lexicographer, the patentee must "clearly set forth a definition of the disputed claim term," and "clearly express an intent to define the term." *Id.* (quoting *Thorner*, 669 F.3d at 1365); *see also Renishaw*, 158 F.3d at 1249. The patentee's lexicography must appear "with reasonable clarity, deliberateness, and precision." *Renishaw*, 158 F.3d at 1249.

To disavow or disclaim the full scope of a claim term, the patentee's statements in the specification or prosecution history must amount to a "clear and unmistakable" surrender. *Cordis Corp. v. Boston Sci. Corp.*, 561 F.3d 1319, 1329 (Fed. Cir. 2009); *see also Thorner*, 669 F.3d at 1366 ("The patentee may demonstrate intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope."). "Where an applicant's statements are amenable to multiple reasonable interpretations, they cannot be deemed clear and unmistakable." *3M Innovative Props. Co. v. Tredegar Corp.*, 725 F.3d 1315, 1326 (Fed. Cir. 2013).

[2] Some cases have characterized other principles of claim construction as "exceptions" to the general rule, such as the statutory requirement that a means-plus-function term is construed to cover the corresponding structure disclosed in the specification. *See, e.g., CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1367 (Fed. Cir. 2002).

III. AGREED CONSTRUCTIONS

The parties have agreed to the following constructions set forth in their P.R. 4-5(d) Joint Claim Construction Chart (Dkt. No. 75).

Term[3]	Agreed Construction
"modulator" • '465 Patent Claims 1, 4 • '535 Patent Claims 1, 2 • '866 Patent Claims 7, 19	any device which outputs an optical signal with controlled variation of intensity, whether the variation is induced during production of the signal (such as in a semiconductor laser) or whether a signal input from another source is modified
"electrode" • '465 Patent Claims 1, 4	the electrical connections of an optical modulator device through which the device is controlled
"digital to digital converter" • '866 Patent Claims 7, 19	a device which maps a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical

Having reviewed the intrinsic and extrinsic evidence of record, the Court hereby adopts the parties' agreed constructions.

IV. CONSTRUCTION OF DISPUTED TERMS

A. "mapping" and "converting"

Disputed Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction
"mapping" • '465 Patent Claims 1, 4	converting a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical	choosing a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs to produce a desired response by the modulator for the given input

[3] For all term charts in this order, the claims in which the term is found are listed with the term but: (1) only the highest-level claim in each dependency chain is listed, and (2) only asserted claims identified in the parties' P.R. 4-5(d) Joint Claim Construction Chart (Dkt. No. 75) are listed.

Disputed Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction
"converting" • '535 Patent Claims 1, 2	mapping a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical	choosing a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs to produce a desired response by the modulator for the given input

Because the parties' arguments and proposed constructions with respect to these terms are related, the Court addresses the terms together.

The Parties' Positions

Plaintiff submits: The terms "mapping" and "converting" are used synonymously in the Asserted Patents to refer to the inventor-defined function of the inventor-defined "digital-to-digital converter," namely, "to refer to a digital-to-digital mapping or conversion that produces output values that are non-identical with the input values" (citing, *inter alia*, '465 Patent col.4 l.62 – col.5 l.3). "Mapping" and "converting" are used consistently throughout the Accused Patents in accord with this definition. Further, during prosecution of the '465 Patent (and related patents), Plaintiff equated the terms with the function of the digital-to-digital converter. Finally, Defendant's proposed construction improperly allows for the output to be identical to the input, and thus lacks any "mapping" or "converting" and would not serve the stated purpose of the invention, "improved linearity of response" (quoting '465 Patent col.2 ll.27–29). Dkt. No. 66 at 9–18.

In addition to the claims themselves, Plaintiff cites the following **intrinsic evidence** to support its position: '465 Patent, at [57] Abstract, figs. 1, 2A, 2B, 4, 8–10, col.2 ll.27–29, col.4 l.62 – col.5 l.3, col.5 ll.49–59, col.6 ll.5–9, col.7 ll.17–25, col.7 ll.33–67, col.11 l.20 – col.12 l.17, col.13 ll.23 – 31, col.13 ll.62–65, col.15 ll.16–22; '535 Patent col.4 l.62 – col.5 l.3; '866 Patent, at [57] Abstract, col.4 l.62 – col.5 l.4; '465 Patent File Wrapper October 20, 2016 Application at 27

(Plaintiff's Ex. 4, Dkt. No. 66-4 at 145–76, 171), August 14, 2017 Office Action (Plaintiff's Ex. 4, Dkt. No. 66-4 at 109–19), February 14, 2018 Response at 2, 7–8 (Plaintiff's Ex. 4, Dkt. No. 66-4 at 50–60, 51, 56–57); '417 Patent[4] File Wrapper January 30, 2015 Response at 2, 9 (Plaintiff's Ex. 5, Dkt. No. 66-5 at 40–57, 41, 48); '191 Patent[5] col.17 ll.4–24 (Plaintiff's Ex. 6, Dkt. No. 66-6).

Defendant responds: The terms "mapping" and "converting" are not defined in the Asserted Patents by association with the digital-to-digital converter. Rather, the Asserted Patents are aimed broadly at producing a desired modulator response for a given input. The "mapping" and "converting" processes do this by "choosing" a specific desired output for a specific input, such as through a lookup table associating inputs with outputs. Plaintiff confirmed this meaning in a recent IPR submission, where it characterized the '465 Patent as directed to methods "to derive the best approximated selection of output value for a given input value" and distinguished a prior-art reference for failing to teach "mapping by 'selecting a binary actuation vector' from among available output voltage vectors" (quoting IPR Preliminary Response[6] at 33, 56, Dkt. No. 71-2 at 40, 63). Further, Plaintiff's use of "set" and "values" in its proposed construction conflicts with the use of those terms in the claims, and therefore generates ambiguity. For example, the output of the mapping of '465 Patent Claim 1 has "M voltage values" based on an input of "N input values" while Plaintiff suggests that the inputs and outputs are themselves "values." Similarly, Plaintiff's use of "possible" in the claims conflicts with the claim language by suggesting the claimed

[4] U.S. Patent No. 9,031,417. The Asserted Patents are related to the '417 Patent through a series of continuation applications. *See, e.g.*, '465 Patent, at [63] Related U.S. Application Data.
[5] U.S. Patent No. 9,479,191. The Asserted Patents are to the '191 Patent through one or more continuation applications. *See, e.g.*, '465 Patent, at [63] Related U.S. Application Data.
[6] Patent Owner's Preliminary Response Under 37 C.F.R. §42.107, *Cisco Systems Inc. v. Ramot at Tel Aviv University Ltd.*, IPR2020-00122 ('465 Patent) (P.T.A.B. Feb. 18, 2020), Paper 9. This appears to be the same document submitted by Plaintiff as Exhibit 14, Dkt. No. 66-14.

mapping/converting works on "multiple possible" inputs and outputs when the claims recite mapping/converting a singular input (of N values) to a singular output (of M values). Finally, a situation in which the input and output are identical would "render[] the claimed mapping/converting unnecessary." Dkt. No. 71 at 5–18.

In addition to the claims themselves, Defendant cites the following **intrinsic evidence** to support its position: '465 Patent, at [57] Abstract, figs.1, 2A, 2B, 4, col.1 ll.56–64, col.3 ll.25–30, col.5 ll.49–54, col.7 ll.5–17, col.7 ll.21–25, col.7 ll.33–39, col.7 ll.45–55, col.8 ll.54–67, col.9 ll.47–56, col.11 ll.55–56; IPR Preliminary Response at 33, 35, 56 (Defendant's Ex. 2, Dkt. No. 71-2 at 40, 42, 63); '465 Patent File Wrapper February 14, 2018 Response at 2 (Defendant's Ex. 3, Dkt. No. 71-3 at 3).

Plaintiff replies: Including "values" as in Plaintiff's proposed construction poses no threat of confusion. While the individual elements of the input or output have "values" so to do the sets of possible inputs and outputs and "[a] person of ordinary skill would be familiar with binary bits and words and vectors and would have no trouble understanding these concepts or explaining them to a jury." Defendant fails to take a position on whether the claimed "mapping" and "converting" encompasses the situation where the set of possible outputs is identical to the set of possible inputs, and this should be clarified. Finally, the claimed "mapping"/"converting" is not limited to "choosing" but encompasses, for example, using an algorithm to determine the output based on the input. Dkt. No. 74 at 4–8.

Plaintiff cites further **intrinsic evidence** to support its position: '465 Patent col.2 ll.39–40, col.3 ll.48–55, col.5 ll.4–7, col.9 l.67 – col.10 l.1, col.10 ll.36–39, col.11 l.3 – col.12 l.62, col.16 l.1.

Analysis

There appear to be three main issues in dispute. First, whether "mapping"/"converting" inputs to outputs necessarily requires a non-identical association between inputs and outputs. It does. Second, whether the "mapping"/"converting" necessarily proceeds by "choosing" from among a prepopulated set of possible outputs. It does not. Third, whether the output derived from the input is necessarily the "desired" output. While "mapping" and "converting" plainly involve a purposeful, non-identical transformation from input to output, the Court declines to read in a "desired" limitation that threatens to exclude less-than-ideal outputs and clarifies little.

The claims provide significant context that informs the meanings of "mapping" and "converting." For instance, Claim 1 of the '465 Patent recites:

> 1. A method for converting digital electrical data into modulated optical streams, said method comprising
> inputting into an optical modulator N bits of digital data in parallel, N being larger than 1;
> ***mapping a set of N input values corresponding to said N bits of digital data to a vector of M voltage values*** where M is equal to or larger than N;
> driving at least M electrodes of the optical modulator, enabled to pulse modulate at least an input optical stream, responsively to the M voltage values, to provide at least a pulse modulated output optical stream.

'465 Patent col.17 ll.4–14. This claim provides the input to the mapping, "a set of N input values corresponding to said N bits of digital data," and the output from the mapping, "a vector of M voltage values." Thus a specific input "set" is mapped to a specific output "vector." A plain reading of the claim suggests that Plaintiff's proposed "set of possible digital output values" language is superfluous or misleading. For example, is a vector necessarily a set? A plain reading of the claim also suggests that Plaintiff's proposed "possible" language is misplaced. For example, one might interpret Plaintiff's proposal as Claim 1 requiring an input set of sets (multiple inputs, each a set) and a output set of vectors (multiple outputs, each a vector). A requirement of multiple inputs and outputs is not supported by the claim language.

"Mapping" and "converting" are not defined in the Asserted Patents by association with the digital-to-digital converter, as Plaintiff posits. Specifically, the Accused Patents provide the following definition of "digital-to-digital converter":

> The phrase "digital-to-digital converter" is used to refer to a device which ***maps a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical***. The "digital-to-digital converter" employed by certain embodiments of the present invention is a non-trivial converter in which there is typically not a one-to-one mapping between bits of the input data and bits of the output data, as will be clear from the description following.

'465 Patent col.4 l.62 – col.5 l.3 (emphasis added). The function here is a broad association of multiple possible inputs to multiple possible outputs. An example of such a broad association is provided in Figure 4 of the patents (reproduced here), which presents an "implementation of the digital-to-digital mapping." *Id*. at col.7 ll.58–66. This table associates a set of possible inputs ("DDC Input" column) with a set of possible outputs ("DDC Output" column). "[T]he input corresponds to the input data word and the output corresponds to the electrode actuation pattern for generating the outputs." *Id*. at col.6 ll.5–9. In other words, a singular input (an input data word) is associated with a singular output (an actuation pattern) through the table which includes multiple such associations. The "mapping" of Claim 1 of the '465 Patent, for example, uses a singular input (e.g., "0010") to create a singular output (e.g., "0100") with which to drive "at least M electrodes of the optical modulator." It does not refer to a

FIG. 4

DDC Input	DDC Output
0000	0000
0001	0011
0010	0100
0011	0101
0100	0101
0101	0110
0110	0111
0111	0111
1000	1000
1001	1001
1010	1001
1011	1010
1100	1011
1101	1011
1110	1100
1111	1101

generalized mapping scheme as depicted in Figure 4, and as contemplated in the definition of "digital-to-digital converter," with which specific input-to-output mapping is accomplished.

The Asserted Patents elsewhere clarify that "mapping" and "converting" may be used to denote the generation or selection of a singular output based on a singular input. For instance, the patents provide:

> There is also provided according to the teachings of the present invention, a method for ***converting*** a digital data input word of N bits into an analog signal comprising: (a) ***processing the digital data input word to generate an electrode actuation vector of M values*** where M≥N; and (b) applying M voltage values corresponding to the actuation vector values to M actuating electrodes of an electrically controllable modulator for modulating the intensity of an optical signal, wherein at least one value of the actuation vector varies as a function of values of more than one bit of the input data word.

'465 Patent col.3 ll.48–58 (emphasis added). This passage refers to generating a singular output ("an electrode actuation vector of M values") using a singular input ("the digital data input word"). In another example, the patents provide:

> In the case described above of FIG. 1, a 4-bit Digital-to-Analog Converter, based on a Multi-Electrode (ME) Mach-Zehnder Interferometer, is presented. The input to the device consists of 4 bits. ***Using the Digital-to-Digital converter, which may be thought of as a look-up table***, the ***4 data bits are mapped to 5 electrodes*** as this realization is equipped with a single excess electrode. According to one option, if an electrical rather than optical output is desired, the optical signal at the output is detected and converted to an electrical (analog) signal.

Id. at col.9 ll.47–56 (emphasis added). Again, this refers to selecting a singular output (values for the "5 electrodes") based on a singular input (the "4 data bits"). Ultimately, the definition of "digital-to-digital converter" defines the capability of that converter, namely, the broad mapping (a scheme that associates each of multiple inputs with an output) that may be used to map an input to an output, rather than defining "mapping" or "converting" which is used elsewhere in the patents, including in the claims, in a slightly different sense.

The "mapping"/"converting" is not necessarily a "choosing." As the Court understands Defendant's proposed construction, the "mapping" or "converting" must necessarily proceed by selecting from among preexisting outputs such as listed in a lookup table. This type of "mapping"/"converting" is supported by the disclosure of the Asserted Patents. For example, as set forth above, the patents note the use of a lookup table like Figure 4. Further, the Accused Patents provide: "The digital-to-digital converter is enabled to map each digital input data word to a binary actuation vector ***by selecting a binary actuation vector from a subset of binary actuation vectors available*** to represent each of the input data words." '465 Patent, at [57] Abstract (emphasis added). The patents do not, however, mandate that all "mapping" or "converting" must be by selecting. For example, as set forth above, the patents specifically disclose "processing the digital data input word to ***generate*** an electrode actuation vector of M values." *Id*. at col.9 ll.47–56 (emphasis added). The patents explain how one might generate an actuation vector, B_i, based on an input, D_i:

> Let D_i denote a digital binary input vector of length N, where i=l, ... , 2^N. For each digital vector D_i, the DDC component in FIG. 1 ***produces*** a corresponding binary vector B_i, of length M. B_i multiplied by v, represents the actual (internal) vector of voltages controlling the M electrodes.

Id. at col.10 ll.37–42 (emphasis added, ellipsis in original). Defining "U_i" as "the ideal analog value required for representing the digital input D_i," the patents teach that the actuation vector B_i that corresponds to D_i can be generated using the following equation, which defines the set of possible actuation vectors:

$$B_i = Dec2Bin_M(\frac{2}{\pi} \arccos(\sqrt{U_i})).$$

Id. at col.11 ll.33–40, col.12 ll.1–13. Thus, the patents contemplate that given an input, say D_2, it is possible to generate an output, B_2, other than by selecting it from a set of preexisting vectors, or "choosing" it, as Defendant posits.

As set forth in the Asserted Patents, the "mapping" or "converting" of input to output is more than simply equating the input and output for all possible inputs. To begin, it appears that the parties may not actually dispute this issue. For example, Defendant represents that if the set of possible outputs was identical to the set of possible input values, this would "render[] the claimed mapping/converting unnecessary." Dkt. No. 71 at 16–17. Further, the patents are directed to curing defects of driving a modulator with the input values, which corresponds to using an output that is necessarily the same as the input. *See, e.g.*, '465 Patent col.1 ll.50–64 (disparaging prior art in which a "serious problem is encountered due to the inherent ***non-linear response*** of the modulator"), col.2 ll.33–34 ("The present invention is a ***linearized*** optical digital-to-analog modulator."). The patents explain that the invention is broadly directed to transforming the response of a modulator from its "natural" response function to a "different" response function:

> Parenthetically, although the present invention is described herein in the context of a preferred example of linearization of a modulator device which inherently has a non-linear response, ***the principles of the present invention may equally be applied to any case where a natural response of a modulator provides a first function and a desired response is a different second function*** which may be linear or non-linear.

'465 Patent col.8 ll.54–61 (emphasis added). This encompasses transforming a non-linear response to something that is closer to a linear response. *See, e.g., id*. at figs.2A–2B, col.7 ll.31–57 (noting that Figure 2A depicts the prior-art "marked deviation from linearity" and that Figure 2B depicts a mapping "according to the teachings of the present invention" in which the output "much more closely approximates to a linear response"). Indeed, this encompasses transforming the natural response to practically any form, as Defendant suggests. *Id*. at col.11 ll.51–58 ("the desired output response function itself may take any desired form"). The invention, however, is directed to transforming the natural response of the modulator to a different response; thus, the mapping/converting set of possible outputs (which may be preexisting or calculable) is necessarily

different in some respect from the set of possible inputs—the set of possible outputs is not identical to the set of possible inputs.

Plaintiff's IPR argument notes that the "mapping" of the claims is based on a set of possible outputs that is not identical to the set of possible inputs, but does not restrict the "mapping" or "converting" to "choosing." For example, Plaintiff submitted the following to the PTAB:

> The digital-to-digital mapping of inputs to different output values is a key mechanism taught and claimed in the '465 Patent for achieving the invented improvements in linearity or other signal characteristics. *See, e.g.*, EX1001, 7:17-66, Figs. 4, 2A & 2B. *Roberts* Table **1** does nothing to accomplish this inventive purpose, because the input values and output ***values*** are identical.
>
> *Roberts* Table **1** merely discloses an identical, one-to-one translation between binary formats. *See also* EX2002, ¶39. As such, it does not teach or suggest "that a binary input data vector D_i has to be mapped to a control vector Bi, yet $B_i \neq D_i$." (EX1001, 11:25-27), or teach or suggest mapping by "selecting a binary actuation vector" from among available output voltage vectors *(id.,* Abstract), or teach or suggest "a device which maps a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical *(id.*, 4:62-65). In fact, because it teaches only a table in which the values represented by the sets on the left are identical to the values represented by the vectors on the right, *Roberts* Table **1** arguably teaches away from the '465 Patent solution. But in any case, *Roberts* Table **1** does not teach or suggest the "mapping" of the challenged claims.

IPR Preliminary Response at 56 (emphasis in original), Dkt. No. 71-2 at 63. While this clearly sets forth that "mapping" in the patents is not a simple identity of input and output, this does not rise to the exacting standard required to limit "mapping" to "choosing."

Finally, the Court declines to include Defendant's proposed "desired" limitation. The Court recognizes that the Asserted Patents use "desired" to refer to the output of the mapping/converting process that transforms the natural response of the modulator to a different response. *See, e.g.*, '465 Patent col.8 ll.54–61 ("the principles of the present invention may equally be applied to any case where a natural response of a modulator provides a first function and a ***desired*** response is a different second function"). The patents also note that the "ideal" response is the "desired"

response. *See, e.g.*, *id*. at col.7 ll.21–25 ("choose the electrode actuation pattern which best approximates a ***desired ideal*** output for the given input" (emphasis added)), col.7 ll.49–50 ("By way of example, in FIG. 2A, it will be noted that output point 22 corresponding to an input of 0011 is higher than ***desired*** for the ***ideal*** linear response." (emphasis added)). It is clear, however, that the invention is not limited to achieving the "ideal" response but rather is aimed at purposefully changing the response, even if the ideal is not reached. *See, e.g.*, *id*. at col.7 ll.54–57 ("An output pattern of 0101 is thus chosen [according to the invention] to correspond to an input of 0011. The overall result is an output which much ***more closely approximates*** to a linear response as shown." (emphasis added)), col.8 ll.14–15 ("where a ***higher degree of linearity*** is needed, further modification may be required" (emphasis added)). Ultimately, including "desired" in a construction threatens to confuse, rather than clarify, claim scope.

Accordingly, the Court construes these terms as follows:

- "mapping" means "selecting or generating a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs, where the set of possible digital outputs and the set of possible digital inputs are not identical" and
- "converting" means "selecting or generating a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs, where the set of possible digital outputs and the set of possible digital inputs are not identical."

B. "pulse modulated"

Disputed Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction
"pulse modulated" • '465 Patent Claim 1 • '535 Patent Claim 1 • '866 Patent Claim 7, 19	plain and ordinary meaning	return-to-zero format

The Parties' Positions

Plaintiff submits: The customary meaning of "pulse modulated," as known in the art, is not limited to a "return-to-zero format." For example, under its customary meaning, "pulse modulated" encompasses both return-to-zero ("RZ") and non-return-to-zero ("NRZ") formats. Rather than defining "pulse modulated" as necessarily RZ format, the Asserted Patents expressly note that RZ format is "**a** pulsed modulation" (quoting '465 Patent col.16 ll.28–30, Plaintiff's emphasis). The patents also disclose NRZ format (citing *id*. at col.16 ll.24–42) and other forms of pulse modulation, such as "use of multiple actuating voltage levels" (quoting *id*. at col. ll.15–20). Further, related and incorporated patents expressly claim "return-to-zero," suggesting that such a limitation should not be read in when not recited, and expressly claim "Pulse Amplitude Modulation," which is typically not RZ format. Finally, in a copending IPR, Defendant proposed a plain-and-ordinary meaning construction of "pulse modulation" that would encompass "encoding of information by varying the basic characteristics of a sequence of pulses, such as width, duration, amplitude, phase or the number of pulses" (quoting IPR Petition[7] at 19–20, Dkt. No. 66-11 at 20–21). Dkt. No. 66 at 19–25.

[7] Petition For Inter Partes Review, *Cisco Systems Inc. v. Ramot at Tel Aviv University Ltd.*, IPR2020-00122 ('465 Patent) (P.T.A.B. Nov. 5, 2019), Paper 2.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '465 Patent figs.1, 10, col.1 ll.6–22, col.2 l.64 – col.3 l.8, col.8 ll.5–9, col.8 ll.15–20, col.13 ll.42–60, col.16 ll.24–42; '835 Patent[8] col.17 ll.9–18 (Plaintiff's Ex. 7, Dkt. No. 66-7); '417 Patent col.19 ll.21–23 (Plaintiff's Ex. 8, Dkt. No. 66-8); '425 Patent[9] col.17 ll.9–10 (Plaintiff's Ex. 9, Dkt. No. 66-9). **Extrinsic evidence**: Blumenthal IPR Decl.[10] ¶¶ 55, 60–61 (Plaintiff's Ex. 10, Dkt. No. 66-10); IPR Petition at 19–20 (Plaintiff's Ex. 11, Dkt. No. 66-11 at 20–21);[11] *IEEE 100 The Authoritative Dictionary of IEEE Standard Terms* at 891 (7th ed. 2000) (Plaintiff's Ex. 12, Dkt. No. 66-12 at 7).

Defendant responds: "[T]he specification only ever uses the term 'pulse modulated' to refer to signals in 'return-to-zero format.'" This is presented in the Asserted Patents as an improvement over NRZ format. Thus, the term should be construed as "return-to-zero format" since "that corresponds to the only disclosure of pulse modulation in the specification, and aligns with the allegedly inventive distinction over NRZ format." Further, recitation of "return-to-zero" format in a related-patent claim is irrelevant as that claim depends from one that is directed to modulation other than "pulse modulation." Similarly, recitation of "Pulse Amplitude Modulation" in a related-

[8] U.S. Patent No. 8,044,835. The Asserted Patents are related to the '835 Patent through a series of continuation applications. *See, e.g.*, '465 Patent, at [63] Related U.S. Application Data.

[9] U.S. Patent No. 9,203,425. The Asserted Patents are related to the '835 Patent through a series of continuation applications. *See, e.g.*, '465 Patent, at [63] Related U.S. Application Data.

[10] Declaration of Daniel Blumenthal, Under 37 C.F.R. § 1.68 In Support Of Petition For Inter Partes Review, *Cisco Systems Inc. v. Ramot at Tel Aviv University Ltd.*, IPR2020-00122 ('465 Patent) (P.T.A.B. Nov. 4, 2019), Exhibit 1003.

[11] The Court treats petitioner's submissions in an Inter Partes Review as extrinsic evidence because these submissions do not necessarily reflect the patent owner's or the PTO's understanding of the patent. *See Aylus Networks, Inc. v. Apple Inc.*, 856 F.3d 1353, 1359–61 (Fed. Cir. 2017) (holding that "***statements made by a patent owner*** during an IPR proceeding can be considered during claim construction and relied upon to support a finding of prosecution disclaimer" (emphasis added)); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1317 (Fed. Cir. 2005) (en banc) ("Like the specification, the prosecution history provides evidence of ***how the PTO and the inventor understood the patent***." (emphasis added)).

patent claim is irrelevant as "that is not the term that is being construed here." Finally, Defendant's IPR plain-and-ordinary-meaning position is irrelevant since a construction "was not necessary to resolve the dispute in the IPRs." Dkt. No. 71 at 18–23.

In addition to the claims themselves, Defendant cites the following **intrinsic evidence** to support its position: '465 Patent figs. 1, 10, col.2 l.64 – col.3 l.9, col.8 ll.5–9, col.14 ll.8–14, col.14 ll.22–24, col.16 ll.24–41; International Publication No. WO 2008/152642[12] (Defendant's Ex. 6, Dkt. No. 71-6); '835 Patent (Defendant's Ex. 7, Dkt. No. 71-7).

Plaintiff replies: The Asserted Patents disclose both RZ and NRZ formats, and multiple pulse-modulation forms, including those that do not use RZ format. Even if the patents disclosed only RZ-format pulse modulation, that would not be enough to limit the claims to RZ format. Dkt. No. 74 at 8–10.

Plaintiff cites further **extrinsic evidence** to support its position: *IEEE 100 The Authoritative Dictionary of IEEE Standard Terms* at 886 (7th ed. 2000) (Plaintiff's Ex. 12, Dkt. No. 66-12 at 8).

Analysis

The issue in dispute distills to whether "pulse modulated" has a special meaning in the Asserted Patents that differs from its customary meaning in the art. It does not.

Nothing Defendant identifies rises to the exacting standard required to alter the customary meaning of "pulse modulate" to "return-to-zero format." Indeed, the patents specify only that RZ format is "a" pulse modulation:

> A simple implementation of this embodiment described thus far generates Non-Return-to-Zero (NRZ) signals. NRZ permits constant intensity for similar

[12] The publication is of PCT Application No. IL/2008/000805, which is related to the Asserted Patents through a continuation-in-part application earlier than the Asserted Patents in the priority chain and through a common priority claim to a provisional application filed on June 13, 2007. *See, e.g.,* '465 Patent, at [63] Related U.S. Application Data; WO 2008/152642, [30] Priority Data, Dkt. No. 71-6 at 2.

> consecutive bits, and is thus more susceptible to Inter-Symbol-Interference and other nonlinear propagation distortions. ***Return-to-Zero (RZ) format is a pulsed modulation*** where the signal "returns to zero" after every bit. This format provides better performance than NRZ**,** but usually requires additional hardware, such as a pulse carver.

'465 Patent col.16 ll.24–32 (emphasis added). This is not lexicography. Further, even if the only embodiment of pulse modulation disclosed in the patents is RZ format, that is not sufficient to limit the customary meaning of the term. *See Thorner v. Sony Comput. Entm't Am. LLC*, 669 F.3d 1362, 1366 (Fed. Cir. 2012) ("It is likewise not enough that the only embodiments, or all of the embodiments, contain a particular limitation. We do not read limitations from the specification into claims; we do not redefine words. Only the patentee can do that."); *SRI Int'l v. Matsushita Elec. Corp.*, 775 F.2d 1107, 1121 (Fed. Cir. 1985) (en banc) ("The law does not require the impossible. Hence, it does not require that an applicant describe in his specification every conceivable and possible future embodiment of his invention."). In fact, Defendant, in its IPR petition, expressly recognized that "pulse modulation" has a broad customary meaning and is not limited to RZ format in the patents:

> The specification of the '465 Patent provides little further guidance. The specification (in material added with the '805 continuation-in-part application) gives one example of a pulsed modulation: "Return-to-Zero (RZ) format is **a pulsed modulation** where the signal 'returns to zero' after every bit." Ex.1001, 16:28-30. ***Claim 1, however, does not refer specifically to an RZ pulse technique***. A POSITA would understand, therefore, that ***the term "pulse modulate" as claimed refers to the plain and ordinary meaning***. Ex.1003, ¶ 92.
>
> The plain and ordinary meaning of pulse modulation, as recognized by a POSITA, would include its dictionary definition: "The encoding of information by varying the basic characteristics of a sequence of pulses, such as width, duration, amplitude, phase or the number of pulses." Ex.1009, p. 891; Ex.1003, ¶ 93.

IPR Petition at 19–20 (bold emphasis in original, bold-italic emphasis added), Dkt. No. 66-11 at 20–21. Defendant's expert echoed this statement in his sworn Declaration:

> [T]he specification gives one example of a pulsed modulation: "Return-to-Zero (RZ) format is a pulsed modulation where the signal 'returns to zero' after every

> bit." . . . However, the claim does not recite the specific example of an RZ pulse technique, thus leaving a POSITA to understand the term "pulse modulate" as claimed refers to the plain and ordinary meaning.

Blumenthal IPR Decl. ¶ 92, Dkt. No. 66-10 at 69.

Defendant's explanation of the inconsistency between its position before the PTAB and its position before the Court is not credible. Notably, Defendant did not simply argue to the PTAB that a construction of "pulse modulated" is unnecessary to resolve the invalidity dispute presented in the IPR. Rather, Defendant affirmatively presented "plain and ordinary meaning" as the proper construction, and even provided a dictionary definition that would be encompassed by the plain and ordinary meaning, which dictionary definition lacks any mention of "return to zero." Further, Defendant represented to the PTAB that—in the '465 Patent—the RZ format is simply "one example of a pulsed modulation." Finally, Defendant submitted studied and sworn expert testimony to the PTAB, with the expert testifying that "pulse modulate" has a customary meaning, as evinced by the dictionary definition, and that it is used according to this "plain and ordinary meaning" in the '465 Patent. Blumenthal IPR Decl. ¶¶ 4–5, 92–94, 222, Dkt. No. 66-10 at 6–8, 69, 136. Defendant's nose-of-wax approach to claim construction is not justified.

Accordingly, the Court rejects Defendant's proposed construction and determines that "pulse modulated" has its plain and ordinary meaning without the need for further construction.

C. "driving at least M electrodes of the optical modulator . . . responsively to the M voltage values"

Disputed Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction
"driving at least M electrodes of the optical modulator . . . responsively to the M voltage values" • '465 Patent Claims 1, 4	plain and ordinary meaning	directly applying the M voltage values to the M electrodes of the optical modulator

The Parties' Positions

Plaintiff submits: The Asserted Patents describe an exemplary embodiment in which the electrodes are "directly" driven by the digital-to-digital converter, but this is labeled "Direct Digital Driving," not simply "driving" as recited in the claims. Thus, the claims are not limited to "direct" driving and allow for customary intervening driver circuitry such as scaling amplifiers or bias circuits. In fact, Defendant presented to the PTAB that the use of such driver circuits in the art is "normal." Dkt. No. 66 at 25–30.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '465 Patent col.1 l.64 – col.2 l.29, col.15 ll.10–12, col.15 l.65 – col.16 l.11, col.16 l.66 – col.17 l.2; IPR Preliminary Response[13] at 26–27 (Plaintiff's Ex. 14, Dkt. No. 66-14 at 33–34). **Extrinsic evidence**: *IEEE 100 The Authoritative Dictionary of IEEE Standard Terms* at 336 (7th ed. 2000) (Plaintiff's Ex. 13, Dkt. No. 66-13 at 4); IPR Petition at 28 (Plaintiff's Ex. 11, Dkt. No. 66-11 at 29); Blumenthal IPR Decl. ¶¶ 28–29, 111, 138 (Plaintiff's Ex. 10, Dkt. No. 66-10); U.S. Patent No. 7,277,604[14] ("*Roberts*") figs.1–2, col.1 l.64 – col.2 l.2 (Plaintiff's Ex. 15, Dkt. No. 66-15).

Defendant responds: As set forth in the claims, described in the patent, and explained by Plaintiff in an IPR, the claimed "driving" requires directly applying the M voltage values to the electrodes. The claims state "driving at least M electrodes . . . responsively to the M voltage

[13] Patent Owner's Preliminary Response Under 37 C.F.R. §42.107, *Cisco Systems Inc. v. Ramot at Tel Aviv University Ltd.*, IPR2020-00122 ('465 Patent) (P.T.A.B. Feb. 18, 2020), Paper 9.

[14] Plaintiff submitted a copy that Defendant submitted to the PTAB as Ex. 1005 to Defendant's IPR Petition. The Court lists this here as "extrinsic evidence" though it is part of the IPR record because it was there submitted by Defendant and the IPR is still in its preliminary phase. That said, it appears that *Roberts* is related through a divisional application to U.S. Patent Application Publication No. 2017/0212076 which is listed on the face of each of the Asserted Patents and is thus intrinsic evidence. *See, e.g.*, '465 Patent, at [56] References Cited; IPR Preliminary Response at 18–19, Dkt. No. 71-2 at 25–26.

values," which indicates that voltage values are used to drive the electrodes. "[E]very embodiment disclosed in the specification explains that the output of the DDC, vector B, is directly applied to electrodes." Further, "the only discussion of 'driving' anywhere in the specification" notes that "'application of the electrical signals is preferably directly upon the modulator without any mediating circuits'" (quoting '465 Patent col.15 ll.10–12). Finally, Plaintiff represented to the PTAB that "directly driving" the electrodes with the actuator vectors is an essential characteristic of the invention. Dkt. No. 71 at 23–31.

In addition to the claims themselves, Defendant cites the following **intrinsic evidence** to support its position: '465 Patent, at [57] Abstract, figs.1, 8, 10, col.3 ll.14–16, col.3 ll.48–58, col.7 ll.14–17, col.13 ll.20–22, col.15 ll.10–12; IPR Preliminary Response at 3, 7, 32–33, 61 (Defendant's Ex. 2, Dkt. No. 71-2 at 10, 14, 39–40, 68); '465 Patent File Wrapper February 14, 2018 Response at 7 (Defendant's Ex. 3, Dkt. No. 71-3 at 8).

Plaintiff replies: The claims require driving "responsively to" the M voltage values, which allows that the "voltage values are inputs to a driver circuit that drives the electrodes." Further, the Asserted Patents describe "'applying M ***voltage values corresponding to the actuation vector values*** to M actuating electrodes,'" which allows the customary use of "intervening driver circuitry to create the voltage values 'corresponding to' the binary actuation vector values" (quoting '465 Patent col.3 ll.48–62). Finally, the Plaintiff's IPR statements do not rise to a clear disclaimer of intervening driver circuitry. Dkt. No. 74 at 10–13.

Plaintiff cites further **intrinsic evidence** to support its position: '465 Patent col.3 ll.48–62; IPR Preliminary Response at 61–62 (Plaintiff's Ex. 14, Dkt. No. 66-14 at 68–69).

Analysis

The issue in dispute distills to whether "driving" electrodes "responsively" to voltage values in the '465 Patent necessarily means "directly applying" the voltage values to the electrodes. While the patent's disclosure presents "application [of the voltages] directly upon the modulator without any mediating circuits" as a preferable, and therefore non-limiting, embodiment, Plaintiff represented to the PTAB that driving the voltages directly onto the electrodes is an essential attribute of the claimed invention. The Court holds Plaintiff to that representation.

The '465 Patent does not redefine "driving" electrodes "responsively" to a vector of voltages to require direct application of the voltages on the electrodes. Specifically, the patent provides as follows:

> The application of the electrical signals is ***preferably*** directly upon the modulator without any mediating circuits, referred to herein as "Direct Digital Driving". The modulator can be regarded as a 2D Digital-to-Analog (DIA) converter, that converts a digital word into an optical vector signal.

'465 Patent col.15 ll.10–15 (emphasis added). The use of "preferably" here clearly indicates that this feature is not coextensive with the claimed invention. Similarly, the patent's description of application of the voltages to the electrodes as "according to the teachings of the present invention" or as a "feature of the present invention" is not definitional of the claimed invention. Rather, these phrases in the patent refer to aspects or embodiments of the invention, not essential attributes. *See, e.g.*, '465 Patent col.2 ll.53–58 (listing "feature[s] of the present invention" that are different, alternative embodiments of the invention). The patent also teaches that a binary output vector (B_i) generated from an input (D_i) using the DDC may be multiplied by voltages such that the output vector components (B_{ij}) are each associated with an electrode-drive voltage (V_j) that is in turn applied to the j^{th} electrode. *Id.* at col.9 l.65 – col.10 l.46 ("B_i multiplied by v, represents the actual (internal) vector of voltages controlling the M electrodes"). In other words, Defendant's statement

that "every embodiment disclosed in the specification explains that the output of the DDC, vector B, is directly applied to electrodes," Dkt. No. 71 at 24, is incorrect. The output of the DDC, vector B, may first be multiplied by voltages to generate the voltages that are applied to the electrodes.

While the '465 Patent itself supports a plain and ordinary meaning of "driving at least M electrodes of the optical modulator … responsively to the M voltage values" Plaintiff's representation to the PTAB in IPR of the '465 Patent requires a narrower meaning. Specifically, Plaintiff clearly represented the claimed "driving" of the electrodes of the '465 Patent is "directly driving" the electrodes with the vector of M voltage values. For instance, Plaintiff explained the claimed invention as follows:

> As discussed above, the '465 Patent discloses and claims techniques for fast modulation of digital data onto optical streams-which is useful in a variety of high-performance, high-bandwidth optical communications applications. *See, e.g.*, EXl00l at Abstract, 1:30-49. ***The claimed techniques included "a digital-to- digital converter that provides a mapping of input data words to binary actuation vectors" suitable for driving the electrodes of an electro-optical modulator device***. *Id.*, Abstract.
>
> Known optical modulators at the time of the patent had characteristics that limited their performance, such as non-linear response. *Id*., 1:56-64, Figure 2A. And known solutions for these problems were inefficient and complicated. *Id*., 1:64-2:29. They often required complex and power-hungry digital to analog converter (DAC) circuits to drive electrodes of the modulator, which were limited in speed. *Id*., 1:64-2:4; *see also* EX1005, 3:8-13. Existing solutions that employed digital signals to drive the electrodes did not correct for problems like modulator non-linearity, or else were needlessly complicated and inefficient. EX1001, 2:5-29.
>
> The '465 Patent ***inventors instead taught and claimed a digital-to-digital converter to map input digital data into digital output data—in the form of digital vectors that could be directly driven onto the electrodes of existing electro-optical modulators***. *Id*., Abstract, 7:5-25, Figure 1 ("DDC"): …
>
> Accordingly, ***the invention of the '465 Patent*** achieved higher performance without the need for analog pre-distortion or signal conditioning circuits or DACs, instead ***directly driving the modulator with digital signal vectors*** and using the optical modulator itself to effect a faster digital-to-analog conversion. *See, e.g.*, EX1001, 15:10-12 ("The application of the electrical signals is preferably directly upon the modulator without any mediating circuits, referred to herein as 'Direct Digital Driving'").

IPR Preliminary Response at 32–33 (emphasis added), Dkt. No. 71-2 at 39–40. This is a clear representation that the actuation vectors of the claimed invention of the '465 Patent are used to directly drive the modulator. Similarly, Plaintiff further explained:

> The Petition does not cite this discussion from *Roberts* here. *See* Petition at 39. And this explanation of **digital-to-analog** conversion and **analog driver signal** conditioning has nothing to do with, and arguably teaches away from, the '465 Patent approach and its **claimed digital-to-digital "mapping" to produce digital voltage values for driving modulator electrodes**. *See, e.g.*, EX1001, 15:10-12. Because the only explanation of "non-linear compensator 18" in *Roberts* refers to a compensation function producing **analog voltage levels** for driving electrodes via a DAC circuit, a person of ordinary skill would not find any teaching or suggestion of the digital-to-digital mapping to digital voltage vectors of the challenged claims.
>
> The outputs of the *Roberts* compensation function are not ***the digital "vector[s] of M voltage values" suitable for "driving at least M electrodes of the optical modulator" of the challenged claims***. *See, e.g.*, EX100l, 17:8-14. Rather, the outputs of the *Roberts* compensation function are "ample streams" computed to cause a digital-to-analog converter to output analog voltages which, after additional filtering, yield analog electrode drive voltages. EX1005, 1:54-2:6. To the extent the Petition suggests that this sample stream could instead be ***directly driven onto electrodes***, the Petition does not cite to any explanation of ***how***—nor does it identify any teaching of *Roberts* that would teach or suggest mapping in that context. *See* Petition at 39.

Id. at 61 (bold emphasis in original, bold-italic emphasis added), Dkt. No. 71-2 at 68. Again, this is a clear representation that the actuation vectors of the claims are "directly driven onto the electrodes."

Plaintiff's statements to the PTAB clearly denote claim scope. These statements "represent[] an ongoing negotiation between the PTO and the [patent owner], rather than the final product of that negotiation" and therefore may "lack[] the clarity of the specification and thus [may be] less useful for claim construction purposes." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1318 (Fed. Cir. 2005) (en banc). The potential lack of clarity is exacerbated in this instance because the IPR is still in its preliminary stage and there is no "final product" of the negotiation between the PTO. Thus, the Court lacks the full context that may inform the meaning of Plaintiff's statements. *See, e.g.*,

Laitram Corp. v. Morehouse Indus., 143 F.3d 1456, 1462 (Fed. Cir. 1998) (noting that when a "snap-shot of the prosecution history is scrutinized in [the] context" of other prosecution-history events, the meaning of the snap-shot may differ). That said, however, "[t]he public notice function of a patent and its prosecution history requires that a patentee be held to what he declares during the prosecution of his patent." *Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335, 1344 (Fed. Cir. 2015). Here, Plaintiff made clear (albeit preliminary) representations of claim scope to the PTAB. "[S]tatements made by a patent owner during an IPR proceeding can be considered during claim construction and relied upon to support a finding of prosecution disclaimer." *Aylus Networks, Inc. v. Apple Inc.*, 856 F.3d 1353, 1359–61 (Fed. Cir. 2017). Even if these statements represent a claim-scope narrowing beyond that necessary, "the question is what a person of ordinary skill would understand the patentee to have disclaimed during prosecution, not what a person of ordinary skill would think the patentee needed to disclaim during prosecution." *Ajinomoto Co. v. ITC*, 932 F.3d 1342, 1351 (Fed. Cir. 2019) (quotation and modification marks omitted). Ultimately, Plaintiff represented to the PTAB—and the public—that the actuation vector, the "vector of M voltage values," is directly driven onto electrodes. The Court here must hold Plaintiff to this representation.

Accordingly, the Court construes this term as follows:

- "driving at least M electrodes of the optical modulator . . . responsively to the M voltage values" means "directly driving at least M electrodes of the optical modulator . . . with the M voltage values."

V. CONCLUSION

The Court adopts the constructions set forth above, as summarized in the following table. The parties are **ORDERED** that they may not refer, directly or indirectly, to each other's claim

construction positions in the presence of the jury. Likewise, the parties are **ORDERED** to refrain from mentioning any portion of this opinion, other than the actual definitions adopted by the Court, in the presence of the jury. Any reference to claim-construction proceedings is limited to informing the jury of the definitions adopted by the Court.

The parties are hereby **ORDERED** to file a Joint Notice within fourteen (14) days of the issuance of this Memorandum Opinion and Order indicating whether the case should be referred for mediation. If the Parties disagree about whether mediation is appropriate, the Parties should set forth a brief statement of their competing positions in the Joint Notice.

Section	Term	Construction
A	"mapping" • '465 Patent Claims 1, 4	selecting or generating a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs, where the set of possible digital outputs and the set of possible digital inputs are not identical
	"converting" • '535 Patent Claims 1, 2	selecting or generating a digital output from a set of possible digital outputs for a given digital input from a set of possible digital inputs, where the set of possible digital outputs and the set of possible digital inputs are not identical
B	"pulse modulated" • '465 Patent Claim 1 • '535 Patent Claim 1 • '866 Patent Claim 7, 19	plain and ordinary meaning
C	"driving at least M electrodes of the optical modulator . . . responsively to the M voltage values" • '465 Patent Claims 1, 4	directly driving at least M electrodes of the optical modulator . . . with the M voltage values

Section	Term	Construction
AGREED	"modulator" • '465 Patent Claims 1, 4 • '535 Patent Claims 1, 2 • '866 Patent Claims 7, 19	any device which outputs an optical signal with controlled variation of intensity, whether the variation is induced during production of the signal (such as in a semiconductor laser) or whether a signal input from another source is modified
	"electrode" • '465 Patent Claims 1, 4	the electrical connections of an optical modulator device through which the device is controlled
	"digital to digital converter" • '866 Patent Claims 7, 19	a device which maps a set of possible digital input values to a set of possible digital output values, where the input and output values are non-identical

So ORDERED and SIGNED this 15th day of May, 2020.

RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE